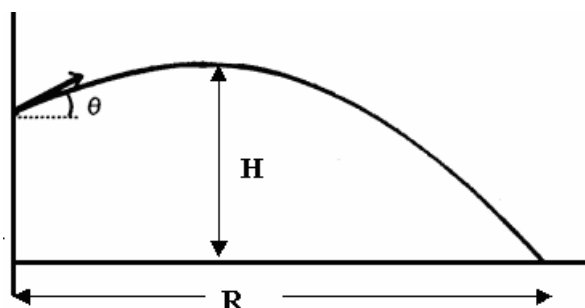


**DISCUSSION:**

The motion of an object moving both horizontally and falling freely under the influence of gravity is referred to as projectile motion. Though the horizontal and vertical motions occur simultaneously, they are otherwise independent of each other. Since there is no horizontal component of acceleration, the velocity in the x-direction will be constant. Likewise, the vertical component of the motion should be that of free-fall. The equation which describes projectile motion, ignoring air resistance and where  $g = 9.81\text{m/s}^2$ , is:

$$\Delta x = v_{ix}t \text{ and } \Delta y = v_{iy}t - \frac{1}{2}gt^2$$

**THE EXPERIMENT:**

1. In your group, determine how you will measure the following variables: Range, Time, and Initial Height. Create a table for your data
2. Launch the tennis ball supplied to your group by throwing it, attempting to achieve maximum range. Be sure to write down any data collected in the data table.
3. Repeat the lab for each group member.

**ANALYSIS:**

**In addition to any necessary measurements or calculations from the experiment itself, include the following in your lab report.**

4. Calculate the horizontal velocity, vertical velocity, angle of the throw, and initial velocity for your personal throw. Show all necessary calculations.
5. Plot the horizontal velocity vs. time. Explain the implications of your graph.
6. Plot the vertical velocity vs. time. Explain the implications of your graph.
7. Derive an expression for the range of the projectile in terms of  $t$ ,  $v$ ,  $\sin \theta$ ,  $\cos \theta$ , and  $g$ .
8. Determine which angle would produce the greatest range, ignore air resistance. Show any calculations or derivations you used.
9. Determine the maximum range for the velocity of your throw based on the angle calculated in the previous question and explain why your projectile did not achieve maximum range.